METHOD AND APPARATUS FOR ESTIMATING BLOOD PRESSURE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from Korean Patent Application No. 10-2015-0149731, filed on Oct. 27, 2015 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] 1. Field

[0003] Apparatuses and methods consistent with exemplary embodiments relate to estimating blood pressure using an artificial neural network algorithm.

[0004] 2. Description of the Related Art

[0005] A cuff-type blood pressure measuring device is bulky, inconvenient to carry, and inadequate for real-time sequential monitoring of blood pressure. Recently, a cuff-less-type blood pressure measuring device has received significant attention.

[0006] The cuffless-type blood pressure measuring device indirectly measures blood pressure by using a source light. For example, by using photoplethysmography (PPG) a change in blood volume at a particular body area is measured, and a waveform of blood volume is analyzed, thus blood pressure is estimated. Another method is measuring a movement of skin on body epidermis due to a change in a blood vessel and estimating blood pressure.

[0007] A blood pressure estimation algorithm prepared by using a statistical method is applied to those methods of measuring blood pressure. A change in blood flow or a change in a movement of skin over the blood vessel is measured, and a correlation between features of these changes and an actually measured blood pressure is statistically determined to obtain the blood pressure estimation algorithm beforehand. In the method of estimating blood pressure, the features of a subject are matched to the blood pressure estimation algorithm.

[0008] However, a degree of accuracy of the estimation performed using the blood pressure estimation algorithm may be reduced depending on subjects.

SUMMARY

[0009] Exemplary embodiments address at least the above problems and/or disadvantages and other disadvantages not described above. Also, the exemplary embodiments are not required to overcome the disadvantages described above, and may not overcome any of the problems described above.

[0010] One or more exemplary embodiments provide methods of estimating blood pressure by applying an artificial neural network algorithm for each of groups classified in accordance with a hemodynamic classification.

[0011] According to an aspect of an exemplary embodiment, there is provided a blood pressure estimation method including: inputting physical characteristic information and blood pressure information of a subject; determining, among a plurality of groups classified according to hemodynamic characteristics, a group to which the subject belongs based on the physical characteristic information and the blood pressure information; detecting a bio-signal of the subject; extracting a plurality of features from the detected bio-signal; and estimating a blood pressure corresponding to the extracted plurality of features and the determined group based on a learned blood pressure estimation algorithm.

[0012] The physical characteristic information may include sex, age, height and weight of the subject.

[0013] The determining comprises classifying the plurality of groups according to hemodynamic characteristics based on a heart rate, systolic blood pressure, diastolic blood pressure, cardiac output, total peripheral resistance change and pulse transit time.

[0014] The detecting of the bio-signal may be detecting a signal in accordance with a pulse wave speed change of light reflected off the subject.

[0015] The signal may be a photoplethysmography (PPG) signal or a pulse transit time signal.

[0016] The extracted plurality of features may include a systolic peak, a reflective peak, a systolic rising time, a reflective peak time and a period of the PPG signal.

[0017] The learned blood pressure estimation algorithm may correspond to a learned artificial neural network algorithm.

[0018] The estimating the blood pressure based on the neural network algorithm may include: learning an artificial neural network algorithm; and estimating the blood pressure by matching the extracted plurality of features to a hidden layer matrix of the learned artificial neural network algorithm.

[0019] The learning of the artificial neural network algorithm may include: inputting the plurality of features to an input layer of the artificial neural network algorithm; inputting a systolic blood pressure and a diastolic blood pressure of the blood pressure information to an output layer of the artificial neural network algorithm; and generating the hidden layer matrix having weights as well as thresholds of input values of the input layer on a hidden layer located between the input layer and the output layer.

[0020] According to another aspect of an exemplary embodiment, there is provided a method of estimating blood pressure including: inputting physical characteristic information and blood pressure information of a subject; detecting a bio-signal of the subject; extracting a plurality of features from the detected bio-signal; and estimating blood pressure by inputting the plurality of features, the physical characteristic information and the blood pressure information to a learned artificial neural network algorithm.

[0021] The estimating blood pressure may include: learning an artificial neural network algorithm; and estimating a blood pressure by matching the physical characteristic information and the plurality of features to a hidden layer matrix of the learned artificial neural network algorithm.

[0022] The inputting of the physical characteristic information and the blood pressure information may include determining, among a plurality of groups classified algorithmically according to hemodynamic characteristics, a group to which the subject belongs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The above and/or other aspects will be more apparent by describing certain exemplary embodiments, with reference to the accompanying drawings, in which:

[0024] FIG. **1** is a schematic block diagram of an apparatus for estimating blood pressure, which is applied to a method of estimating blood pressure, according to an exemplary embodiment;